

PVB is more difficult to process, and there is considerable manufacturing yield loss.

Stiffer glass laminates have been made using interlayers other than PVB, such as polyurethanes and thermoplastic copolymers and all of these, including PVB, in combination with polyester film and polycarbonate films. Bolton et al, U.S. Patent No. 4,663,228, for example, describes the use of an ionomer resin to form tough glass laminates.

There is an increased need for glass laminates for use as architectural windows that are resistant to the threats of wind storms and hurricanes, particularly in coastal areas. There is also a need for side windows for vehicles that are intrusion resistant. These glass laminates are required to have improved toughness and stability. They must also be easily fabricated, and have good optical properties - including color and clarity.

It is desirable to meet such needs with a PVB laminate that is tough, stable, and easily fabricated, and has good optical properties. These, and other objects of the invention will become apparent to the reader.

SUMMARY OF THE INVENTION

In one aspect, the present invention is a laminate article comprising at least two layers of soft plasticized polyvinylbutyral (PVB) sheet having a T_g in the range of from about 32°C to about 35°C and further comprising at least one layer of a stiff PVB interlayer sheet, wherein the stiff interlayer: (i) has a T_g of from about 35°C to about 60°C; (ii) is positioned between at least two layers of soft PVB; and, (iii) comprises a bleaching compound.

DETAILED DESCRIPTION OF THE INVENTION

In one embodiment, the present invention is a laminate article comprising at least three layers of plasticized polyvinylbutyral (PVB) sheet, wherein at least one layer of the laminate is a stiff PVB sheet and at least two layers are soft PVB sheets. A laminate article of the present invention is useful for providing increased protection from damages occurring to automobiles, buildings, and windows by virtue of exposure of same to, for example, hurricane force winds, impact from debris propelled by high winds, or by intentional impact against windows comprising the laminates of the present invention.

In the practice of the present invention, both soft and stiff PVB can be manufactured according to conventional processes known in the art of PVB manufacture. For example, a method of producing a soft PVB composition suitable for the practice of the present invention is described in U.S. Pat. No. 3,153,009, incorporated herein by reference. Plasticized PVB sheeting can be prepared by processes well known in the art. U.S. 4,276,351 describes a process for preparing plasticized PVB sheeting. U.S. Patent Number 4,696,971 also describes a process for manufacturing plasticized PVB sheeting. U.S. Patent 5,886,075 describes yet another process for manufacturing plasticized PVB sheeting.

A laminate of the present invention comprises at least two layers, or zones, of soft PVB. Soft PVB, as the term is used in the present invention, refers to PVB sheet that has a glass transition temperature (T_g) in the range of from about 32°C to about 42°C, as measured by Dynamic Mechanical Analysis ASTM D4065 (DMA), using the tangent delta (phase shift at 1 Hz) data as indicator.